



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
[www.uspto.gov](http://www.uspto.gov)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/804,411	03/19/2004	David Garrett	12	7365
22046	7590	06/01/2009	EXAMINER	
Docket Administrator - Room 2F-192			PERILLA, JASON M	
Alcatel-Lucent USA Inc.			ART UNIT	PAPER NUMBER
600-700 Mountain Avenue			2611	
Murray Hill, NJ 07974				
MAIL DATE		DELIVERY MODE		
06/01/2009		PAPER		

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b>	<b>Applicant(s)</b>
	10/804,411	GARRETT, DAVID
	<b>Examiner</b>	<b>Art Unit</b>
	JASON M. PERILLA	2611

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

1) Responsive to communication(s) filed on 27 April 2009.  
 2a) This action is **FINAL**.                  2b) This action is non-final.  
 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

4) Claim(s) 1-3 is/are pending in the application.  
 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.  
 5) Claim(s) \_\_\_\_\_ is/are allowed.  
 6) Claim(s) 1-3 is/are rejected.  
 7) Claim(s) \_\_\_\_\_ is/are objected to.  
 8) Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

9) The specification is objected to by the Examiner.  
 10) The drawing(s) filed on 19 March 2004 is/are: a) accepted or b) objected to by the Examiner.  
     Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
     Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).  
 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
 a) All    b) Some \* c) None of:  
     1. Certified copies of the priority documents have been received.  
     2. Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
     3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

1) <input type="checkbox"/> Notice of References Cited (PTO-892)	4) <input type="checkbox"/> Interview Summary (PTO-413)
2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)	Paper No(s)/Mail Date. _____ .
3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)	5) <input type="checkbox"/> Notice of Informal Patent Application
Paper No(s)/Mail Date _____.	6) <input type="checkbox"/> Other: _____ .

## **DETAILED ACTION**

1. Claims 1-3 are pending in the instant application.

### ***Response to Argument***

2. Applicant's remarks, filed April 27, 2009, have been fully considered.

The Applicant admits that sphere decoding (i.e., reference Lei) is "known in the art" and that the use of log-likelihood ratios in decoding (i.e., reference Yakhnich) is also "known in the prior art". However, the Applicant argues that, in the combination of Lei in view of Yakhnich and Chan, there is no motivation to combine the teachings of Chan with Lei and Yakhnich. Chan is used by the examiner to cover the claimed limitation of "bit flipping".

However, although Chan might not explicitly disclose the particular advantages which result from "bit flipping", one skilled in the art would find the teachings implicit in Chan's disclosure or apparent when taken in light of other knowledge generally known in the art. Specifically, because each bit in a candidate vector has an individual reliability, the inference which is made from the disclosure of Chan is that additional candidates (beyond those gathered from the sphere search) may be made by "bit flipping" the "least reliable" bits of any candidate vectors to generate additional candidates. Although the additional candidates will require additional time to decode via the likelihood techniques, they are still valuable because they are yet derived bearing a high indicia of reliability because they were derived from candidates of the sphere set (which is extracted to be the most reliable set) by only modifying what was

"least reliable" of them. To one having ordinary skill in the art, the advantages of using Chan's "bit flipping" technique are apparent.

***Claim Rejections - 35 USC § 103***

3. The following is a quotation of 35 U.S.C. § 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-3 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Lei et al ("Reduced Complexity Maximum Likelihood Detection for V-Blast Systems"; IEEE Military Communications Conference, 2003 MILCOM, Vol. 2, pgs. 1386-1391, Oct. 2003; "Lei") in view of Yakhnich et al (U.S. Pub. No. 2002/0122510; "Yakhnich"), and in further view of Chan et al ("A Simple Taboo-Based Soft Decision Decoding Algorithm for Expander Codes"; IEEE Communications Letters, Vol. 2, No. 7, pgs. 183-185, July 1998; "Chan").

Regarding claim 1, Lei discloses a method for decoding a received vector symbol which corresponds to a binary string having a plurality of bit positions (abstract), comprising: (a) performing a sphere search so as to obtain an initial set of candidate vectors (pg. 1386, col. 2; pg. 1387, col. 2, "Polygon local searching detector"). Lei discloses determining an initial set of candidate vectors. Because comparing each received symbol against an array of every possible symbol transmitted is too exhaustive, the set of possible candidate received symbols is reduced using Lei's sphere search (pg. 1386, col. 2). In Lei's example sphere search, (i.e. fig. 2) an

Art Unit: 2611

"exhaustive search over all the signal points within the defined region" is performed by a maximum likelihood ("ML") decoder (pg. 1387, col. 2). Regardless of the number of candidate vectors determined in the sphere search, one of the candidate vectors is considered a most likely candidate as understood by one having ordinary skill in the art because it has the lowest cost function. Lei does not disclose specifically (1) computing a log-likelihood ratio for each of said bit positions, wherein each said ratio is based on values of a cost function computed for at least some candidate vectors belonging to the initial set, and (2) on values of the cost function for at least some further candidate vectors constructed by flipping one or more bits of the most likely candidate vector. However, Yakhnich teaches, in a strictly analogous maximum likelihood detector (abstract), determining log-likelihood ratios based on cost functions of candidate vectors (¶¶ 0085-0088; Table 1 illustrates the possible "candidate vectors" of an "initial set"). That is, Yakhnich teaches that the ML algorithm actually determines log-likelihood ratios based on values of a cost function computed for at lease some candidate vectors (¶¶ 0087 and 0088). Therefore, it would have been obvious to one having ordinary skill in the art at the time which the invention was made that the ML algorithm of Lei could be utilized to determine log-likelihood ratios based on values of a cost function computed for at lease some candidate vectors because, as taught by Yakhnich, the method is well known and accepted in the art.

Further regarding claim 1, Davis in view of Yakhnich do not disclose that log-likelihood ratios are determined for some cost functions constructed by flipping one or more bits of the most likely candidate vector. However, Chan teaches, in an analogous

decoding technique, a method of flipping bits in a candidate vector to assist in decoding with fewer decoding iterations (abstract). Chan teaches flipping the “least reliable nontaboo variable” (i.e. bit) to assist in decoding (pg. 184, “Soft Decision Decoding Algorithm”). Therefore, it would have been obvious to one having ordinary skill in the art at the time which the invention was made to flip the least reliable bit as taught by Chan in the method of Lei in view of Yakhnich because it would lead to better and faster decoding of the received signal.

Regarding claim 2, Lei in view of Yakhnich, and in further view of Chan disclose the limitations of claim 1 as applied above. Davis in view of Yakhnich, and in further view of Chan do not explicitly discloses that the initial set of candidate vectors at least one vector that has been excluded by the sphere search as lying outside a search radius. However, as plainly understood by one having ordinary skill in the art, the choice of the “sphere” size is directly attributed to the amount of candidates that one wishes to evaluate. While the specification provides that “in at least some cases, it will be advantageous to include in S' (the candidate vectors) some or all of the leaf nodes that have been tested but have failed the radius test (i.e. are outside the “sphere”), in order to provide good soft information”, one skilled in the art further understands that the choice of the size of the sphere is directly related to how “good” the soft information is. That is, a balance between an amount of soft candidate vector information to be evaluated and time and resource constraints must be maintained. Therefore, including at least one candidate vector which lies outside the “sphere” is simply analogous to making the “sphere” appropriately larger depending upon the aforementioned “balance”.

The specification does not provide any indication of non-obviousness with respect to choosing a candidate that is “outside” the sphere. Specifically, it provides no actual advantage as compared to simply making the “sphere” larger. Therefore, it would have been obvious to one having ordinary skill in the art at the time which the invention was made that the “sphere” could be made larger *or* the entry of candidates outside the sphere could, likewise, be admitted for evaluation depending upon the number of candidates that one wishes to evaluate.

Regarding claim 3, Lei in view of Yakhnich, and in further view of Chan disclose the limitations of claim 1 as applied above. Further, Chan discloses that at least some further candidate vectors are constructed by flipping precisely one bit of the most likely candidate vector as applied in claim 1 above.

### ***Conclusion***

5. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Art Unit: 2611

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to JASON M. PERILLA whose telephone number is (571)272-3055. The examiner can normally be reached on M-F 8-5 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chieh M. Fan can be reached on (571) 272-3042. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Jason M Perilla/  
Primary Examiner, Art Unit 2611  
May 28, 2009

/jmp/